UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Climate Change Impacts On Geohazards

2526-2-F7401Q110

Title

Climate Change Impacts On Geohazards

Teacher

Fabio Vittorio De Blasio

Language

Italian/English

Short description

1. A short introduction to climate science
   1.1 The difficult acceptance of climate change in the history of geology. How scientists came to conclude that the climate has changed in the past; introductory view of the Geosciences between the end of the 18th century and the early years of the XX century; the birth of quaternary science; the role of glacial erosion and deposition as a fundamental prove of glaciations; radical change of ideas about glaciations between Agassiz and the work of Penck and Bruchner, and the acceptance of glacial theory; modern views of glaciers; description of glaciers; accumulation and ablation areas; glacier dynamics; role of the external temperature

1.2. The climate of the past: how scientists determine the changes in temperatures, sea level, and gas content of the atmosphere based on different proxies. Isotopic stratigraphy, glacial corings, examples from EPICA data; Glaciations of the past and alternation with warm climate
1.3 Story of climate from the late Proterozoic to the climate of today and with increasing details as we approach the present days: ancient glaciations, the alternations of warm and cold periods in the Paleozoic and Mesozoic; PETM and the Eocene warm period; the global cooling starting from the Oligocene, further cooling leading to the Quaternary glaciations; list of the most important MIS, glacial-interglacial episodes; examples of interglacial deposits in northern Italy (Pianico and Leffe); short-period oscillations in the latest interglacial, Dansgaard-Oeschger episodes, Heinrich events; Bond events; the older and younger Dryas, Bolling-AllerØd, the Holocene; deglaciation; The European Holocene (Pre-Boreal, Boreal, Atlantic, sub-Boreal, sub-Atlantic); climate-induced collapse of civilizations;

2. The drivers of climate
   2.1. The atmosphere system: a very short introduction to the atmospheric composition, temperature, moisture

2.2 The laws of radiation: blackbody radiation, the Stefan-Boltzmann law, solar constant, albedo

2.3 Back to the past: causes of glaciations in the light of the atmospheric physics; solar periodicities; Orbital periodicities; Croll-Milankovitch theory of insolation and glaciations;

2.3 Greenhouse gases: Absorption of radiation by the atmosphere; greenhouse gases and their role in increasing the temperature

3. Data on recent climate change and atmospheric hazards
   3.1 Data collections and how to read them. Data from various papers and compilations; temperature change in the last 170 years; atmospheric temperature change as a function of the height (troposphere and stratosphere); humidity change; water columns and global precipitation changes; streamflows, wind changes
   3.2. Global circulation and global changes; the Hadley, Ferrel, and Polar cells; Walker circulation; ENSO; monsoons, tropical and extratropical cyclones, jet currents and how they affect global climate

3.2. Ocean and ice: Arctic and Antarctic ice; terrestrial snow cover; permafrost; eustatic sea level change; salinity change; change in length and volume of glaciers;
Marine biosphere;

4. Climate Change and Natural Hazards
   4.1. Climate change in mountain areas. The Alps, Apennines, The Himalayas; data and projections;

4.2. Debris flows and landslides. Specific examples; very short introduction to debris flows; which types are affected by climate; GLOFs; events due to rapid snowmelt;

4.3. Trends in debris flows frequencies. Data from Austria, Italy, and Switzerland; data and trends of frequency;

4.3. Trends in rockfall and small rock avalanche frequencies. Crash course in rockfalls and rock avalanches; rockfalls frequency and trends in permafrost and in ice-free areas; effect of bias and genuine trends; mechanical model of permafrost rock-slope stability; trends in slope oversteepening and slope debuttressing caused by glacier retreat; climate-induced trends of coastal rockfalls and soilfalls;

4.3. Trends in large and slow landslide frequencies trend in the velocity of slow, monitored landslides; effect of evapotranspiration on such trends; rock glaciers; effect of snowmelt on the flow rate; effect of extreme precipitations; climate impact drivers; analysis of landslide impacts on the different continents.

Material:

1. Power point slides
2. F.W. Taylor. 2005. Elementary Climate Physics. Oxford Univ. Press.
3. J. Ehlers. 2022. The Ice age. Springer.
4. N. Roberts. 2009. The Holocene. An environmental history. Wiley.
5. Three papers chosen by the students expanding on a particular topic and explained by the students in a seminar with power point slides
6. More books on climate and Quaternary geology from which salient aspects were extracted
7. Various scientific articles, from which the important material was extracted

Target audience

students

Maximum number of participans

10

Assessment method

1. Mid-semester exam:
   Preparation and presentation of a seminar (based on two or three papers) on an
   aspect of the course that the student found particularly interesting.
   The seminar will assess the student's ability to select salient aspects
   from a narrow subtopic, create an engaging PowerPoint presentation, and discuss it.
2. Final oral exam:
   2a) Some of the slides shown in class are selected as a starting point; the student is then invited to discuss them
   in detail, explain their meaning, and open other related images, if necessary.
   2b) The student will be asked to delve deeper into some more quantitative topics from the books used in class.

CFU / Hours

6/48

1. Teaching: 18 2-hour face-to-face lessons

2. Interactive teaching:
   2a) Exercises in atmospheric physics and basic principles of climatology (with calculations): 3 2-hour face-to-face lessons
   2b) Seminar preparation, partial reading of articles: 3 2-hour face-to-face lessons

Teaching period and mode

first semester

Sustainable Development Goals

NO POVERTY